Art. V.—*Notes on some Victorian Species of Teredo.*

by

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and

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(With Plates XII., XIII.).

[Read June 10th, 1915].

Through the courtesy of Mr. G. Kermode, Engineer of Ports and Harbours, and Mr. H. Hopcraft, contractor, of Flinders, an opportunity has been afforded us of examining closely the depredations of our Victorian shipworms, and of ascertaining the specific identity of the creatures responsible for this ravaging work. The alterations at Lakes Entrance provided some excellent material for examination. Mr. Kermode kindly forwarded a piece of Oregon pine about two feet in length, completely riddled by these vermiform mollusks—many of them being alive—the result of eighteen months' immersion. In March, 1914, the Portsea Pier was in course of repair, nine of the piles, of a species of Eucalyptus, being removed. They were badly infested, and with the generous assistance of Mr. Hopcraft, specimens with the animal, shell, and pallets complete were procured. From time to time, considerable attention has been paid to the shipworms, owing to their damaging effects; and from a scientific standpoint, these peculiar mollusks have provided much scope for the anatomist and systematist. Much has been written on the subject and the synonymy will show how, more or less, the species have been misunderstood, many early writers, and engineers' reports, attributing the work of these "worms" to *Teredo navalis*, whereas the mischief has been caused by several species. To quote Forbes and Hanley, "Writers of the Linnaean school, both British and Foreign (with the honourable exception of Spengler), contented themselves with classing all the shipworms under the one appellation *navalis*, describing the tube, but neglecting the more important anterior valves and the characteristic pallets."

We have experienced difficulty in separating the species by the valves, and, apart from the animal, we regard the pallet as the one certain means of identification.

Early in the field of Victorian writers was the Chief Harbour Master of Williamstown, Captain Ferguson, who, in a report on Class III. Indigenous Vegetable Substances Catalogue of the Victorian Exhibition of 1861, pp. 8-11, issued a "Return, showing the approximate injury done by the *Teredo navalis*, and other sea-worms, to submerged timbers within the waters of Victoria," giving interesting and commendable particulars under the following heading:—

Locality.	Date when pile was driven.	Description of timber.	Depth of water from the bottom surface to high water mark.	Diameter of pile when driven.	Present thickness of pile at low water line.	Destruction of pile by worms.	Strength of tide when pile was driven.	Fresh or sea water.
		Red Gum, Stringy-bark, Blue Gum, White Gum, Blackwood, Sheoak, Teak (vessel) Swan River—Mahogany.				So many inches in so many years.		

Attributing the injury to *Teredo navalis*, whereas, it is probable that a scientific examination would have revealed the existence of all the species under question.

Under the name of *Calobates saulii*, E. P. Wright, in 1866, described a form, the type locality of which is given as Port Phillip, Australia. Following this, the "Victorian Naturalist," Dec., 1888, published one of the first lists of Victorian Marine Mollusca, compiled by the senior author of this paper, in which will be seen a record of *T. navalis*, Linn. In a paper, entitled "The Marine Wood-Borers of Australasia and Their Work," read before the Australasian Association for the Advancement of Science, year 1901, Mr. C. Hedley discussed at length the shipworms under the following headings:—General Aspect, Propagation, As an Esculent, Natural Enemies, and Classification. In the latter we are unable to concur in all his decisions. Firstly, Mr. Hedley remarks "neither the species *navalis* nor the genus *Teredo* are present in our waters." Here we differ, and report its undoubted existence in Victoria. The other points of difference are detailed in the observations of each species.

Pritchard and Gatliff also dealt with the forms in their catalogue of the Marine Shells of Victoria, but, as will be seen, alterations have been found necessary.

The destruction of these pests has proved a matter of considerable anxiety. Countless schemes having been advanced, adopted, and found wanting. An American plan, as quoted by Marshall in the Journal of Conchology, 1914, p. 207, shows some practicability, and should have a fair measure of success. It is as follows:—"The latest method to be adopted for overcoming this destruction and loss to wharves, harbours, and submarine works generally, has been successfully carried out by American contractors who can now electrocute them by millions, and although the process is not altogether permanent in its effects, yet by occasional applications it is proving sufficient to overcome the difficulties experienced in many extensive operations, and to supersede the use of divers and other highly-skilled operatives. The method of electrocution is carried into effect by the use of a floating electric-power plant, capable of generating heavy currents of electricity at a comparatively low intensity. A net work of wires is first lowered into the sea facing the wharf or harbour to be attacked, and these are coupled with one of the poles of the dynamo on the vessel; similar wires are then suspended beneath the ship in electrical contact with the other pole. Directly the current is switched on, electrolytic action occurs in the sea water between the two metal nets, and chlorine gas is thereby liberated. This deadly gas envelopes the *Teredines* in their borings, and speedily causes death."

From the timber mentioned in this paper we have obtained and critically examined over 300 pallets. Four species, all of which were detected in the one piece of timber, at Lakes Entrance, three of them also being present in the timber of the piles at Portsea Pier, constitute the representation of shipworms in Victoria, as far as we have been able to ascertain; three at least most probably having been introduced by ships from European localities.

They are as follow:—

Teredo navalis, Linn.

1767. Teredo navalis, Linn. Syst. Nat. ed. 12, p. 1267.

1806. Teredo navalis, Linn. Home, Phil. Trans., pl. 12, f. 7-10.

1828. Teredo navalis, Linn. Chiaje, Memorie., Vol. IV., pp. 23 and 32, pl. 54, f. 2 and 8.

1853. Teredo navalis, Linn. Forbes and Hanley, Brit. Moll., Vol. I., p. 74, pl. 1, f. 7, 8, and pl. 18, f. 3, 4.

1862. Teredo navalis, Linn. Chenu, Man. de Conch., Vol. II., p. 10, f. 59.

1875. Teredo navalis, Linn. Reeve, Conch. Icon., pl. 1, f. 1a, b.

1884. Teredo navalis, Linn. Tryon, Syst., Conch., Vol. III., p. 120, pl. 104, f. 48.

1884. Teredo navalis, Linn. Sowerby, Thes. Conch., Vol. V., pl. 469, f. 1, on plate not f. 2 (numerals on plate reversed).

1893. Teredo navalis, Linn. Clessin, Conch. Cab., Vol. XI., p. 67, pl. 15, f. 3-6.

Hab.—Lakes Entrance.

Obs.—The characteristic little pallet readily serves to distinguish the species. It is composed of a thick, shelly plate, flat on one side and convex on the other, with its extremity bifurcated. The plate, devoid of a central rib, has a strong cylindrical stalk of lesser length. European specimens in the National Museum, Melbourne, cannot be separated from our series.

Teredo bruguieri, Delle Chiaje.

1792. Teredo norvagicus, Spengler. Skriv. Nat. Selsk., Vol. II., p. 102, pl. 2, f. 4-6, B (not binomial).

1822. Teredo navalis, Linn. Turton, Dithyra Brit., p. 14, pl. 2, f. 1-3.

(?) 1822. Teredo navalis, Linn. Sowerby, Genera, Vol. 1., pl.

1827. Teredo navalis, Linn. Crouch, Introd. Lam. Conch., pl. 2, f. 10.

1828. Teredo bruguieri, Delle Chiaje. Memorie., Vol. IV., pp. 28 and 32, pl. 54, f. 9-12.

1844. Teredo navalis, Linn. Brown, Ill. Conch. G. Brit., p. 116, pl. 50, f. 3, 6, 7.

1852. Teredo navalis, Linn. Sowerby, Man. (4th edition), p. 291, pl. 2, f. 48, 49.

1853. Teredo norvagica, Spengler. Forbes and Hanley, Brit. Moll., Vol. I., p. 66, pl. 1, f. 1-5, and pl. F, f. 1.

1856. Teredo norvegica, Spengler. H. and A. Adams, Genera., Vol., II., p. 332, pl. 90, f. 6, a, b, c, d.

1862. Teredo norvegica, Spengler. Chenu, Man. de Conch., Vol. II., p. 11, the third figure only of fig. 60.

1873. Teredo antarctica, Hutton. Cat. Mar. Moll., p. 59.

1875. Teredo norvagica, Spengler. Reeve, Conch. Icon., pl. 1, f. 1c, d; 2a, b, c.

1880. Teredo antarctica, Hutton. Man. N.Z., Moll., p 133.

1880. Teredo norvegica, Spengler. Woodward, Man., p. 507, f. 270 (in text), and pl. 23, f. 26, 27.

1884. Teredo norvegica, Spengler. Tryon, Syst. Conch., Vol. III., p. 120, pl. 105, f. 70-73.

1884. Teredo (Xylotrya) antarctica, Hutton (?). E. A. Smith, "Alert," Zool., p. 93, pl. 7, f. E-E2.

1884. Teredo norvegica, Spengler. Sowerby, Thes. Conch., Vol. V., pl. 469, f. 2, on plate, not f. 1 (numerals on plate reversed).

1887. Teredo norvegica, Spengler. Fischer, Man. de Conch., p. 1138, f. 869, 870.

1893. Teredo norvegica, Spengler. Clessin, Conch. Cab., Vol. XI., p. 64, pl. 15, f. 7-9, in explanation of plate (not f. 1-3 as in text).

1893. Teredo antarctica, Hutton. Clessin, Conch. Cab., Vol. XI., p. 76, pl. 20, f. 12, 13, in explanation of plate (not f. 11-13, as in text).

1894. Teredo edax, Hedley. P.L.S.N.S.W., Vol. IX., pp. 501-505, pl. 32, f. 1-5.

1894. Teredo antarctica, Hutton. Hedley, P.L.S.N.S.W., Vol. IX., p. 503, pl. 32, f. 6, 7.

1898. Teredo antarctica, Hutton. Hedley, P.L.S.N.S.W., Vol. XXIII., p. 95.

1901. Nausitoria antarctica, Hutton. Hedley, Aust. Ass. Adv. Sci., Vol. VIII., p. 248, pl. 10, f. 9 in explanation of plate (erroneously 8 on plate), is japonica, Clessin, and not antarctica after Clessin.

1901. Nausitoria edax, Hedley. Aust. Ass. Adv. Sci., Vol. VIII., p. 248, pl. 10, f. 5 in explanation of plate (erroneously 6 on plate).

1903. Nausitora edax, Hedley. Pritchard and Gatliff, P.R.S., Vic., Vol. XVI. (N.S.), p. 98.

1913. Teredo bruguieri, Delle Chiaje. Suter, Man. N.Z. Moll., p. 1019, pl. 55, f. 7, a-d.

1914. Teredo norvegica, Spengler. Marshall, Journ. of Conch., Vol. XIV., p. 207.

Hab.—Drift timber, Balnarring, Western Port; San Remo; Lakes Entrance; Portsea Pier; Port Albert.

Obs.—Spengler's name being non-binomial, the employment of *norvegica* is inadmissable. Much confusion has arisen in regard

to this species. The earlier writers, more particularly those of the British school, discussing and figuring the various parts under the appellation of *Teredo navalis*. Forbes and Hanley grasped the distinction, minutely describing and illustrating the animal, valves, pallets, and tube. That the species has since been misunderstood is obvious from the following observations. The description of *T. antarctica*, Hutton, leaves no doubt as to its identity with *T. norvegica*, Spengler. Endeavouring to establish *T. antarctica*, Hutt., Mr. Hedley (loc. cit) figured the type valves and later on illustrated the pallet (after Clessin). Through an unfortunate discrepancy in the text-figure numerals in the Conchylien Cabinet, Mr. Hedley erroneously copied the pallet figure of *T. japonica*, Clessin, to represent *antarctica*. Clessin's text-figure numbers of *T. antarctica*, Hutton, are 11 to 13, while the shell is illustrated by two figures only, 12 and 13, as in the explanation of Plate, figure 11 being the pallet of *japonica*, and not *antarctica*. Mr. H. Suter, in his Manual of the New Zealand Mollusca, p. 1021, notes Mr. Hedley's wrongful figure of the pallet of *antarctica*, and remarks, "is certainly the bipinnate pallet of *T. navalis*, but not *T. antarctica*." In this respect we disagree with Mr. Suter, Clessin's figure depicting *T. japonica*.

Actual comparison of British examples of *T. norvegica* in the National Museum, Melbourne, with a specimen kindly identified from the type by the author as being his *T. edax*, fails to disclose any differentiating characters, and we regard them as absolutely synonymous. Closely allied is the British form *T. megotara*, Hanley, but, as the author remarks, the species may be separated by the pallets being less elongated in the handle, and they taper to a fine point at the apex. In the other they are blunt at the termination and solid throughout. We have examined specimens of *T. megotara* in our museum collection, and notice the distinction. The calcareous tube of *T. norvegica* exhibits a strong concamerated structure at the posterior extremity, vanishing anteriorly where the tube becomes fragile; these characters showing better development in some cases than in others. The largest burrow we have examined was from the Portsea Pier; it attained a length of two feet six inches, and the large bat-shaped pallet abstracted therefrom measured 28 mm. The size and structure of the tube lend aid as a means of identification.

We wrote to Mr. H. Suter stating that we considered *T. edax*, Hedley, to be a synonym of *T. bruguieri*, and asked his opinion. He wrote in reply, "I think that *T. edax*, Hedley, is most likely a synonym of *T. bruguieri*."

Teredo pedicillatus, Quatrefages.

1849. Teredo pedicillatus, Quatrefages. Ann. Nat. Sci. Ser. 3, Zool. Vol. II., p. 26, pl. 1, f. 2.

1875. Teredo pedicillatus, Quatrefages. Reeve, Conch. Icon., pl. III., f. 11a, b, c.

1884. Teredo pedicillatus, Quatrefages. Sowerby, Thes Conch., Vol. V., pl. 469, f. 14.

1893. Teredo pedicillata, Quatrefages. Clessin, Conch. Cab., Vol. XI., p. 68, pl. 17, f. 12-14.

1914. Teredo pedicillata, Quatrefages. Marshall, Journ. of Conch., Vol. XIV., p. 207.

Hab.—Lakes Entrance; Portsea pier.

Obs.—As representing the pallet of this species we are unable to accept the figures by Reeve, Sowerby, and Clessin, their illustrations being quite at variance with Quatrefages' original description—"Les palmules sont étroites, allongees et portees â l'extrémite d'une sorte de manche d'apparence cartilagineuse. Ce pédicule est toujours blanc, tandis que les palettes qui le terminent sont colorées en brune fonce." The remarks by Sowerby—"Palmulae biarticulatae. The pallets are very peculiar, being divided by a horny joint,"—fail to convey Quartrefages' meaning. Our National Museum collection contains specimens under this name from Guernsey, and an actual comparison endorses our identification.

Teredo (Xylotrya) saulii. E. P. Wright.

1866. Nausitora saulii, E. P. Wright. Trans. Linn. Soc Lond., Vol. XXV., p. 567, pl. 65, f. 9-15.

1875. Teredo saulii, Wright. Reeve, Conch. Icon., Vol. XX., pl. 3, f. 10a, b, c, d.

1884. Teredo saulii, Wright. Sowerby, Thes. Conch., Vol. V., p. 123, pl. 469, f. 18.

1893. Teredo saulii, Wright. Clessin, Conch. Cab., Vol. XI., p. 70, No. 10, pl. 17, f. 7-9.

1894. Nausitora saulii, Wright. Hedley, P.L.S.N.S.W., Vol., IX., p. 503.

1898. Calobates saulii, Wright. Hedley, P.L.S.N.S.W., Vol. XXIII., p. 94, f. 7-9.

1901. Nausitoria saulii, Wright. Hedley, Aust. Ass. Adv. Sci., Vol. VIII., p. 248, pl. 10, f. 6 in explanation of plate (not f. 5 in plate).

1901. Nausitora saulii, Wright. Tate and May, P.L.S.N.S.W., Vol. XXVI., p. 421.

1903. Nausitora saulii, Wright. Pritchard and Gatliff, P.R.S. Vic., Vol. XVI (N.S.), Pt. 1, p. 97.

1903. Nausitora thoracites. Pritchard and Gatliff (non Gould), P.R.S. Vic., Vol. XVI. (N.S.), Pt. 1, p. 98.

1913. Teredo saulii, Wright, Suter, Man. N.Z., Moll., p. 1021, pl. 55, f. 8, a, b.

Hab.—Lakes Entrance; Portsea Pier.

Obs.—Of the Victorian representatives, this species alone belongs to the group possessed of articulated pallets, a grouping adopted by Quatrefages and others. They are extremely fragile. Surmounted on a thin, cylindrical stalk is a lamina or blade composed of imbricating and pectinate joints, flat on the inner area, and rounder on the outer. Much variation exists in respect to the number of articulations and their approach to one another; however, the general character is apparent, and the pallet serves as a ready means of recognition. On the assumption that the pallet of *T. fragilis*, Tate, was incomplete, and represented the basal joint of *Calobates saulii*, Wright, Mr. Hedley, P.L.S.N.S.W., 1898, p. 95, states: "The apparent difference in the pallets is due to the fracture of the specimens figured, wherein all joints but the basal one have been snapped off," and, therefore, he reduced it to a synonym, this synonymy in turn being accepted by Tate and May, Pritchard and Gatliff, and Suter. We are much indebted to Dr. J. C. Verco for sending to us for examination the type pallet of *T. fragilis*, Tate. This enables us to pronounce the validity of Tate's species. Herewith a figure of the type is presented, which, consistent with the author's description, "small shelly clavate pallets, the stalk much attenuated, the enlarged, somewhat compressed upper portion crowned with a cartilaginous crust, which has a projecting horn at each end," cannot be confused with a basal joint.

Possibly the authentic specimens seen by Mr. Hedley may not be identical with the type sent to us.

The articulations of the pallet of *T. saulii* are formed on a continuing stalk, whilst in *T. fragilis* the stalk does not continue beyond the base, but is merged into it; this fact, in our opinion, conclusively proves that the pallet of the latter cannot be a fractured pallet of *T. saulii*.


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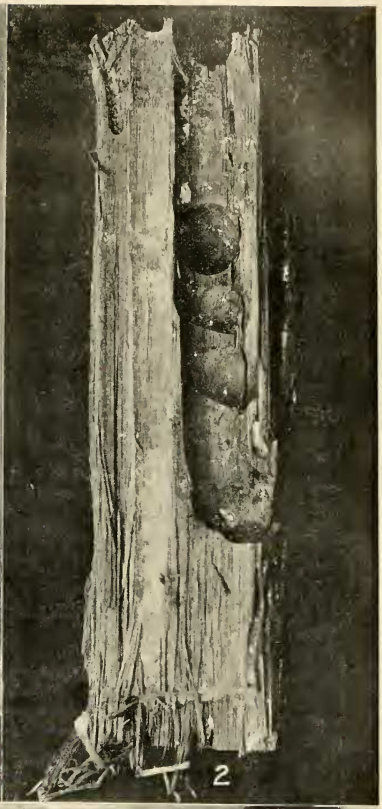
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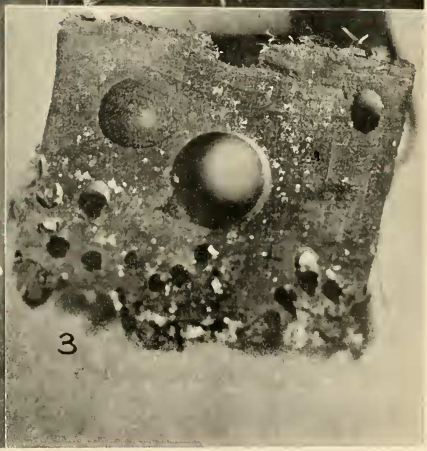
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